Appropriate management of pancreatic cysts: What every radiologist needs to know

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Learning objectives

1. Review the strengths and limitations of various cross sectional imaging modalities for characterization of pancreatic cysts.

2. Highlight current controversies surrounding the appropriate management of pancreatic cysts.

3. Discuss the differences in current international guidelines for appropriate management of pancreatic cysts.

Background

Pancreatic cysts can be broadly divided into neoplastic and non-neoplastic cysts.

The commonest non-neoplastic pancreatic cyst is the pseudocyst, which is a complication of pancreatitis. The pancreatic pseudocyst also represents the most commonest pancreatic cyst in all patients.[1]

Neoplastic pancreatic cysts are less common, but these lesions represent a source of diagnostic and management dilemmas for clinicians. This presentation will focus mainly on this smaller group of lesions.

Imaging findings OR Procedure details

Types of cystic pancreatic lesions:

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serous cystic tumors</td>
<td>Serous cystadenoma, Serous cystadenocarcinoma</td>
</tr>
<tr>
<td>Mucinous cystic tumors</td>
<td>Mucinous cystadenoma, Mucinous cystadenoma with moderate dysplasia, Mucinous cystadenocarcinoma (noninfiltrating/infiltrating), Intraductal papillary mucinous adenoma, Intraductal</td>
</tr>
</tbody>
</table>
papillary mucinous neoplasm with moderate dysplasia, Intraductal papillary mucinous carcinoma (noninfiltrating/infiltrating), Solid pseudopapillary tumors

Lymphoepithelial cysts
Non-neoplastic pancreatic cysts
Reactive lesions without malignant potential; includes pseudocysts and inclusion cysts

Cystic degeneration in solid pancreatic tumors

**Pseudocysts vs. Pancreatic cystic neoplasms:**

In the absence of an etiology for pancreatitis, all pancreatic cysts should be assumed to be pancreatic cystic neoplasms (PCN)

Preceding symptoms of pancreatitis can help with identification of patients with pancreatic pseudocysts, as is the MRI finding of non-enhancing debris within. This finding is thought to be specific for a pancreatic pseudocyst. [2]

Only a small portion (4%) of patients with PCN present with hyperamylasemia, but many have features that overlap with the clinical picture of pancreatitis complicated by a pseudocyst. [3]

The management and diagnosis of pancreatic pseudocysts is fairly well established, and mainly involves drainage of the pseudocyst via percutaneous or endoscopic drainage, or surgical drainage/resection.

**Pancreatic Cystic Neoplasms (PCNs)**

A majority of PCNs are detected incidentally on imaging, although few of these patients present with mass effect and symptoms of malignancy.

Incidental PCNs are prevalent [4] and are now commonly detected, especially with CT, due to increasing usage of cross-sectional imaging in the assessment of patients.

Among the types of PCNs listed above, serous cystic neoplasms, mucinous cystic neoplasm and intraductal papillary mucinous neoplasms are the most prevalent asymptomatic types of PCNs. [5] Their features are summarized in the table below:
Summary of common PCN characteristics:

<table>
<thead>
<tr>
<th></th>
<th>SCN</th>
<th>MCN</th>
<th>IMPN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td>F &gt; M (1:3-4, M:F) 60-80 years old</td>
<td>F &gt; M (1:9, M:F) 30-50 years old</td>
<td>M = F 60-80 years old</td>
</tr>
<tr>
<td><strong>Imaging characteristics</strong></td>
<td>Microcystic/honeycomb appearance</td>
<td>Unilocular cyst +/- Septations and wall calcifications +/- Solid component Located mainly in the body/tail of the pancreas Malignant features: Calcifications, thick wall (&gt;2 mm), septations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Central calcifications (20%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fluid characteristics</strong></td>
<td>Thin, if sufficient fluid aspirated from a dominant cyst</td>
<td>Usually viscous</td>
<td>Usually thick</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>No surveillance or treatment unless symptomatic</td>
<td>Resection is generally recommended in appropriate candidates</td>
<td>Resection for MD-IPMN Resection/surveillance for BD-IPMN</td>
</tr>
<tr>
<td><strong>Percentage of PCN</strong></td>
<td>~ 30%</td>
<td>~50%</td>
<td>~25%</td>
</tr>
</tbody>
</table>

**Controversy about asymptomatic patients with PCNs**

The entity of asymptomatic patients with PCNs is a diagnostic and management challenge. This is because of several factors.
The commonest detected incidental PCN is < 10 mm in size, and the prevalence of non-classical PCN

PCNs represent a heterogenous group of neoplasms, which range from benign (SCNs), premalignant and malignant (MCNs, IPMNs). These neoplasms share many similar imaging characteristics, particularly when they are small in size (<2 cm diameter). Classic imaging characteristics of these neoplasms are not always present, and thus differentiation between the types of PCNs are challenging.

Even within the most common group of PCNs, the MCNs, there is a wide variation of biological behavior, as evidenced by the wide distribution of reported incidence of malignancy. This may be because there is difficulty sampling the tumor histologically, and the progression from benign to malignant is thought to be clonal progression, in an adenoma-carcinoma sequence. [7]

Thus, no one imaging modality has been conclusively shown to be able to accurately differentiate between benign and malignant PCNs, and reports place the accuracy of diagnosis in the range of 25-30%.

Long term survival rate patients with PCNs that receive surgery at better than pancreatic adenocarcinoma, which is a potentially treatable entity.

Therefore, patients diagnosed with PCN can receive potentially curative surgery, but weighed against this is the morbidity and mortality of complications of pancreatic surgery, particularly in more extensive surgeries such as Whipple's.

If the asymptomatic patient with a benign PCN received surgery, the risk of the procedure would far outweigh any potential therapeutic benefit.

Radiologists, surgeons and gastroenterologists have tried to address the question of how best to manage PCNs. An example of this is the Sendai consensus guidelines published in 2006, which were recently updated in 2012. Despite these guidelines, much controversy remains, and research into the most appropriate imaging follow-up of incidental pancreatic cysts are still ongoing.

Radiologists' recommendations for further evaluation of PCN are thus variable. [8]

Strengths and limitations of various imaging available for characterization of pancreatic cysts
<table>
<thead>
<tr>
<th></th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>1. Shows calcifications</td>
<td>1. May not be able to demonstrate the cystic component</td>
</tr>
<tr>
<td></td>
<td>2. Possible to acquire thin slices of different enhancement phases in a single breath hold.</td>
<td>2. Does not demonstrate communication with pancreatic duct</td>
</tr>
<tr>
<td>MRI</td>
<td>1. Detects smaller lesions</td>
<td>1. Increased cost, increased imaging time</td>
</tr>
<tr>
<td></td>
<td>2. Shows the relationship of the cyst to the pancreatic duct</td>
<td>2. Cannot detect central calcifications</td>
</tr>
<tr>
<td></td>
<td>3. Combines parenchymal, ductal and vascular imaging of the pancreas</td>
<td></td>
</tr>
<tr>
<td>EUS</td>
<td>1. Guides aspiration for fluid analysis</td>
<td>1. Operator dependent</td>
</tr>
<tr>
<td></td>
<td>2. Both diagnostic and therapeutic, most sensitive for detecting cysts</td>
<td>2. Unable to characterize large lesions well</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Invasive</td>
</tr>
</tbody>
</table>

Guidelines:

**International Consensus Guidelines / Sendai (2012)**[9]

Aim: To differentiate MCN from BD-IPMN

Rationale: MCNs are generally solitary and do not recur after complete resection, however BD-IPMNs are multifocal in up to 30% of patients. In addition, there is a >10% recurrence rate in patients with non-invasive IPMN who undergo partial pancreatic resection with negative margins.

Aim: Guidelines for incidental finding of PCN in an asymptomatic patient

Guidelines in Fig. 2 on page 12.


Aim: Surgical management of PCN

Guidelines in Fig. 3 on page 13.

Table/Summary of Guidelines

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Aims</td>
<td>Differentiate BD-IPMN from MCN</td>
<td>Guidelines for incidental PCNs</td>
<td>Recommendations for PCNs</td>
</tr>
<tr>
<td>Red flag criteria</td>
<td>Obstructive jaundice in head of pancreas PCN</td>
<td>Clinical and biochemical signs of pancreatitis and biliary obstruction</td>
<td>Imaging features of MCN or MD/mixed-IPMN</td>
</tr>
<tr>
<td></td>
<td>Enhancing solid component</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dilated pancreatic duct</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size criteria</td>
<td>Yes, only in non-red flag patients +/- negative EUS</td>
<td>Yes, only in asymptomatic patients</td>
<td>Yes, but only in BD-IPMN</td>
</tr>
<tr>
<td>Usage of EUS</td>
<td>As a problem solving tool and for monitoring</td>
<td>None</td>
<td>Used to differentiate pseudocyst from macrocystic MCN</td>
</tr>
<tr>
<td>Surgery (if no contraindications)</td>
<td>Suspicious PCN on clinical/imaging/EUS findings</td>
<td>n SCN &gt; 4cm, and uncharacterized PCN &gt; 3cm</td>
<td>Offered in IPMN, MCN, and symptomatic pseudocysts/SCN</td>
</tr>
</tbody>
</table>
May be considered in good surgical candidates in 2-3 cm and >3 cm PCN

| Management of smaller (<2 cm) PCN | < 1 cm: imaging in 2-3 years | 1-2 cm: yearly imaging x 2 years, then lengthen interval if stable | Interval imaging in 1 year; if stable considered benign and no further follow-up required | Not addressed |

Examples of management of PCN:

**Example 1: Management of PCN > 3 cm**

![Axial and coronal CECT images of a incidental PCN in a 48 year old female, which reveal a single septum (arrow). In view of the size of the PCN (> 3cm), the patient subsequently underwent EUS (bottom row) which revealed internal calcification and multiple septations. Both modalities showed no pancreatic duct dilatation or mural nodule. The](Fig. 4: Example 1 Management of PCN > 3 cm (Clockwise from top left): Axial and coronal CECT images of a incidental PCN in a 48 year old female, which reveal a single septum (arrow). In view of the size of the PCN (> 3cm), the patient subsequently underwent EUS (bottom row) which revealed internal calcification and multiple septations. Both modalities showed no pancreatic duct dilatation or mural nodule. The)
patient received laproscopic distal pancreatectomy and splenectomy, and histology of the lesion was a mucinous neoplasm of the pancreas with low-grade dysplasia.

**References:** Department of Diagnostic Radiology, Tan Tock Seng Hospital - Singapore/SG

**Example 2: Management of PCN > 3 cm**

![Image](image_url)

**Fig. 5:** Example 2: Management of PCN > 3 cm (From left to right: T2w coronal, post-contrast T1w fat-saturated axial and coronal MRI) This patient was a 63 year old lady with 3.5 cm incidental PCN in the pancreatic tail (arrows). There was no mural nodule or pancreatic duct dilatation, findings which were confirmed on subsequent EUS. Subsequent laparoscopic distal pancreatectomy was performed and histology revealed a adenocarcinoma with an adjacent mucinous cyst, which raises the possibility that the adenocarcinoma originated from a mucinous cystic neoplasm.

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**Example 3: PCN more than 1 cm and less than 2cm**
Fig. 6: Example 3: PCN more than 1 cm and less than 2 cm Clockwise from top left: Axial and coronal CECT of the pancreas reveals a 1.2 cm microcystic PCN in the pancreatic tail (arrow), which was closely associated with the splenic vein on the coronal image. Subsequent EUS (bottom row) confirms the lesion with microcystic and macrocystic components. No mural nodule or pancreatic duct dilatation was detected in either modality. The endoscopist did not attempt to FNA the lesion as it was closely associated with the splenic vein.

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Example 3: PCN more than 1 cm and less than 2 cm
**Fig. 7:** Example 3: PCN more than 1 cm and less than 2 cm Top 2 rows: Axial and coronal CECT of the pancreas of a 75 year old female reveals multiple PCN (that measure up to 1.1 cm) in the pancreatic head and body, one of which appears to communicate with a side branch of the pancreatic duct (arrow), suggesting BD-IPMN Bottom row: Subsequent EUS confirms multiple PCN in the head and body; one cyst in the head had a mural nodule within (arrow). FNA was performed, but histology was not conclusive.

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Images for this section:

Fig. 1: Management pathway of PCN stated in International Consensus Guidelines 2012

a. Pancreatitis may be an indication for surgery for relief of symptoms.
b. Differential diagnosis includes mucin. Mucin can move with change in patient position, may be dislodged on cyst lavage and does not have Doppler flow. Features of true tumor nodule include lack of mobility, presence of Doppler flow and FNA of nodule showing tumor tissue.
c. Presence of any one of thickened walls, intraductal mucin or mural nodules is suggestive of main duct involvement. In their absence main duct involvement is incoludive.
d. Studies from Japan suggest that on follow-up of subjects with suspected BD-IPMN there is increased incidence of pancreatic ductal adenocarcinoma unrelated to malignant transformation of the BD-IPMN(s) being followed. However, it is unclear if imaging surveillance can detect early ductal adenocarcinoma, and, if so, at what interval surveillance imaging should be performed.
Fig. 2: Management pathway of PCN as stated by ACR Incidental Findings Committee
Fig. 3: Management pathway of PCN suggested by Edirimanne S, Connor SJ in World J Surg (2008)
Fig. 4: Example 1 Management of PCN > 3 cm (Clockwise from top left): Axial and coronal CECT images of a incidental PCN in a 48 year old female, which reveal a single septum (arrow). In view of the size of the PCN (> 3cm), the patient subsequently underwent EUS (bottom row) which revealed internal calcification and multiple septations. Both modalities showed no pancreatic duct dilatation or mural nodule. The patient received laproscopic distal pancreatectomy and splenectomy, and histology of the lesion was a mucinous neoplasm of the pancreas with low-grade dysplasia.

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Conclusion

Pancreatic cysts are increasingly detected incidentally; this may lead to unnecessary follow up. Every radiologist should be familiar with the crucial role that imaging plays in assessment of pancreatic cysts, in order to guide the appropriate management of these lesions.

References


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